AMENDMENTS TO THE SPECIFICATION:

Please amend the paragraph beginning at page 1, line 5, as follows:

The ~~present invention~~ technology of this disclosure relates in general to wireless communication and in particular to wireless communication transmitter systems.

Please amend the paragraphs beginning at page 2, line 22, through page 3, line 6 as follows:

An object of ~~the present invention~~ one or more non-limiting embodiments is to provide for using one and the same transmitter system for constant-envelope as well as non-constant envelope modulation schemes. Another object is to provide a transmitter system for non-constant envelope modulation schemes based on non-linear power amplifier elements. A further object ~~of the present invention~~ is to provide the possibility for fast switching between different modulation schemes.

The above objects are achieved by ~~methods and devices according to the enclosed claims~~ one or more non-limiting example embodiments. In general~~ words~~, a double TRU (Transceiver Unit) is used. The output signals from the power amplifiers are combined to one common output signal provided to an antenna arrangement. A DSP (Digital Signal Processor) of each TRU comprises means for a constant-envelope modulation scheme and a non-constant envelope scheme. The DSP:s select the modulation scheme according to modulation information provided together with the input digital signal. In such a way, a switching between different modulation schemes can be performed even on a time-slot basis.

In case of a non-constant-envelope modulation, the DSP divides the modulated signal into two component signals. Each TRU takes care of the amplification of one component, and the components are eventually combined before being provided to the antenna arrangement. A phase LO compensation of at least one of the TRU:s is performed in order to correct for different paths or phase positions of the power

amplifiers. The non-constant envelope modulated signal can also be a multi-carrier signal, e.g. of two or more constant-envelope signals.

Please amend the paragraphs beginning at page 3, line 9, as follows:

The arrangement can also be operated according to TCC (Transmitter Coherent Combining) of constant-envelope modulated signals, where both TRU:s are provided with the same digital signal. The two amplified output signals are combined to create an output signal of double the amplitude. Also here, phase compensation is ~~necessary~~ desirable.

The phase compensation is preferably determined by monitoring the output power or monitoring the power in the load of the hybrid and comparing with expected output power. In one non-limiting example embodiment, a calibration of the phase compensation is performed during TCC bursts, and utilized during non-constant envelope modulation. Other non-limiting example embodiments utilize constant amplitude portions of non-constant envelope time slots for performing phase compensation calibration. One may then make use also of power measurements of the output signals from each power amplifier. The phase compensation calibration can also be performed during well-characterized training sequences within the time slots.

Please amend the paragraphs beginning at page 4, line 17, as follows:

FIG. 6 is a block diagram illustrating ~~an~~ a non-limiting example embodiment of a double transmitter unit according to the present invention;

FIG. 7 is a flow diagram illustrating ~~an embodiment of~~ a non-limiting example method for providing two constant envelope modulated signals according to the present invention;

FIG. 8 is a flow diagram illustrating ~~an embodiment of~~ a non-limiting example method for providing a non-constant envelope modulated signal according to the present invention;

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FIG. 9 is a flow diagram illustrating ~~an embodiment of~~ a non-limiting example method providing transmitter coherent combining according to the present invention;

FIG. 10 is block diagram illustrating another non-limiting example embodiment of a double transmitter unit according to the present invention;

FIG. 11 is a flow diagram illustrating another ~~embodiment of a~~ non-limiting example method for providing a non-constant envelope modulated signal according to the present invention;

FIG. 12 is a flow diagram illustrating another ~~embodiment of a~~ non-limiting example method providing transmitter coherent combining according to the present invention;

Please amend the paragraph beginning at page 5, line 3, as follows:

FIG. 14 is a block diagram of a part of yet another non-limiting example embodiment of a double transmitter unit according to the present invention;

Please amend the paragraph beginning at page 5, line 6, as follows:

FIG. 16 is a block diagram illustrating an alternative phase shifter solution applicable to one or more non-limiting examples the present invention;

Please amend the paragraphs beginning at page 5, line 10, as follows:

FIG. 18 is a block diagram illustrating a part supporting frequency hopping of ~~an~~ a non-limiting example embodiment of the present invention;

FIG. 19 is an illustration of a storage of phase shifts usable together with one or more non-limiting examples the present invention; and

FIG. 20 is a block diagram of one transmitter unit supporting double carrier signals of ~~an~~ a non-limiting example embodiment of a double transmitter unit according to the present invention.

Please amend the paragraphs beginning at page 8, line 7, as follows:

~~An~~ A non-limiting example embodiment of a double transmitter unit arrangement 45 ~~according to the present invention~~ is illustrated in FIG. 6. A first modulation unit 50 has an input 51 for receiving a digital signal to be transmitted. The input 51 is connected to a DSP (digital signal processor) 52. The DSP 52 comprises modulation means; a 8PSK modulator 53 and a GMSK modulator 54. The DSP 52 also comprises a control input 49 for receiving modulation information, and a selector 55. The selector 55 selects one of the modulators 53, 54 according to the modulation information received by the control input 49. The digital signal received by the input 51 is thereby provided to one of the modulators 53, 54. The different means in the DSP 52 ~~are~~ can be implemented as software.

The GMSK modulator 54 modulates the input digital signal according to the GMSK scheme. The modulated signal is in this embodiment provided in a real I and an imaginary part Q at two outputs, connected to an analogue signal generator 56. In this embodiment, the analogue signal generator 56 comprises ~~essentially~~ a quadrature modulator 57. The analogue signal generator 56 also comprises ~~in turn~~ two DAC's (Digital-to-Analogue Converters) 58, 59 converting the I and Q signals, respectively, into analogue voltages. The analogue voltages are modulated in a mixer 60 with the carrier frequency, provided by a frequency generator 61, and combined. A phase shifter 62 shifts the frequency signal to the Q component by 90 degrees. The output from the analogue signal generator 56 is thus an analogue voltage signal being modulated, in this case according to the GMSK scheme.

Please amend the paragraphs beginning at page 12, line 10, through page 14, line 11 as follows:

In FIG. 7-9, the above operations are illustrated as flow diagrams. First, in FIG. 7, ~~an embodiment of~~ a non-limiting example method of providing two GMSK signals on one carrier each ~~according to the present invention~~ is illustrated. The procedure starts in

~~step~~ act 100. In ~~step~~ act 101, a first digital signal is provided to a first transmitter unit. This first digital signal is intended to be transmitted on a first carrier. In ~~step~~ act 102, a second digital signal is provided to a second transmitter unit. This second digital signal is intended to be transmitted on a second carrier. In ~~step~~ act 103, constant-envelope modulation information is provided to the first transmitter unit. In ~~step~~ act 104, constant-envelope modulation information is provided to the second transmitter unit. A constant-envelope modulation scheme is selected and applied in the first transmitter unit according to the modulation information in ~~step~~ act 105, and a constant-envelope modulation scheme is selected and applied in the second transmitter unit according to the modulation information in ~~step~~ act 106. A first analogue signal corresponding to the first digital signal modulated according to the information is generated in ~~step~~ act 110. A second analogue signal corresponding to the second digital signal modulated according to the information is generated in ~~step~~ act 111. In ~~step~~ act 112, the first analogue signal is amplified and in ~~step~~ act 113, the second analogue signal is amplified. In ~~step~~ act 114, the two amplified signals are combined to a two-carrier output signal to be transmitted. The procedure is ended in ~~step~~ act 115.

FIG. 8 illustrates an ~~embodiment of a~~ example non-limiting method of providing a signal modulated according to a 8PSK modulation according to the present invention is illustrated. The procedure starts in ~~step~~ act 120. In ~~step~~ act 121, a digital signal is provided to a first transmitter unit and the same digital signal is also provided to a second transmitter unit. In ~~step~~ act 123, non-constant-envelope modulation information is provided to the first transmitter unit and to the second transmitter unit. A non-constant-envelope modulation scheme is selected and applied in the first transmitter unit according to the modulation information in ~~step~~ act 125, and a non-constant-envelope modulation scheme is selected and applied in the second transmitter unit according to the modulation information in ~~step~~ act 126. In ~~step~~ act 127, the modulated signal in the first transmitter is separated into a first and a second component. In ~~step~~ act 128 the modulated signal in the second transmitter is separated into the same first and second components. The first

component is phase shifted in ~~step~~ act 129 to compensate for differences in phase characteristics between the paths through amplifier stages of the first and second transmitter unit, respectively. A first analogue signal corresponding to the first phase-shifted component is generated in ~~step~~ act 130. A second analogue signal corresponding to the second component is generated in ~~step~~ act 131. In ~~step~~ act 132, the first analogue signal is amplified and in ~~step~~ act 133, the second analogue signal is amplified. In ~~step~~ act 134, the two amplified signals are combined to a single-carrier output signal to be transmitted. The procedure is ended in ~~step~~ act 135.

FIG. 9 illustrates the case of a TCC operation. The procedure starts in ~~step~~ act 140. In ~~step~~ act 141, a digital signal is provided to a first transmitter unit and the same digital signal is provided also to a second transmitter unit. This digital signal is intended to be transmitted with a double intensity. In ~~step~~ act 143, constant-envelope modulation information is provided to the first transmitter unit and to the second transmitter unit. A constant-envelope modulation scheme is selected and applied in the first transmitter unit according to the modulation information in ~~step~~ act 145, and a constant-envelope modulation scheme is selected and applied in the second transmitter unit according to the modulation information in ~~step~~ act 146. The first modulated signal is phase shifted in ~~step~~ act 149 to compensate for differences in phase characteristics between the paths through amplifier stages of the first and second transmitter unit, respectively. A first analogue signal corresponding to the first digital signal modulated according to the information and phase-shifted is generated in ~~step~~ act 150. A second analogue signal corresponding to the second digital signal modulated according to the information is generated in ~~step~~ act 151. In ~~step~~ act 152, the first analogue signal is amplified and in ~~step~~ act 153, the second analogue signal is amplified. In ~~step~~ act 154, the two amplified signals are combined to double the amplitude of a single-carrier output signal to be transmitted. The procedure is ended in ~~step~~ act 155.

The three flow diagrams exhibit large resemblances. The changes in the different ~~steps~~ acts are of such a character, that it can be changed by e.g. software as a response on

e.g. the modulation information given. Such information can be provided on a time-slot basis, i.e. the requested modulation can be changed from one time-slot to the next. This implies that also the different operational modes ~~of the present invention preferably~~ are interchangeable from one time-slot to the next.

Please amend the paragraph beginning at page 16, line 7, as follows:

The situation may, however, be somewhat more complex if the arrangement is designed also for frequency hopping. In FIG. 18, a part of a double transmitter arrangement ~~according to the present invention~~ is illustrated. The analogue signal generator 56 of the first modulation unit 50 is illustrated to have access to two different frequency generators 61A and 61B. A switch 68 connects one frequency generator at a time to the quadrature modulator 57. In the meantime, the other frequency generator is controlled to be tuned to the next frequency to use. When the frequency change is to be carried through, the switch 68 selects the ~~next~~ <u>other</u> frequency generator. Each frequency used may influence the amplifier equipment to give different phase shifts. This means that the phase shift applied to the signal to be amplified in e.g. TCC or 8PSK mode has to be calibrated at that particular frequency. If the phase shifts are calibrated during TCC mode and stored to be used in 8PSK mode, there has to be one phase shift value for each frequency used by the arrangement. Also, the two frequency generators 61A and 61B may give rise to different phase shifts, whereby one calibrated phase shift for each combination of frequency generator and frequency is needed. A signal can be sent from the frequency generators 61A, 61B to the phase shifter 63 by a connection 86, for instructing the phase shifter which phase shift to apply.

Please amend the paragraph beginning at page 18, line 29, as follows:

Above, one embodiment of shifting the phase of a signal is illustrated. However, anyone skilled in the art understands that also other phase-shifting devices and methods can be employed ~~in order to achieve the functions of the present invention~~. When

operating in ~~a~~ the TCC mode, one attractive alternative arises. FIG. 16 illustrates some selected parts of a transmitter arrangement having an alternative phase-shifting arrangement. The power meter 93 is as before connected to a phase shifter 63. However, in this embodiment, the phase shifter 63 is directly connected to the GMSK modulation means in the DSP 52. The phase shifter 63 evaluates the power signals from the power meter 93 and provides a requested phase shift AO to the GMSK modulation means 54. The GMSK modulation means 54 uses typically a tabulated state machine 98 operating according to a transfer function between the phase shift induced by the digital signal and time. A graph of such a function is illustrated in FIG. 17. The transfer function is draw with a full line and denoted by 210. By simply adding the phase shift $\Delta\theta$ provided by the phase shifter 63 to the value achieved from the transfer function, the entire signal will be provided with an additional phase shift. The phase-shift compensated transfer function will then look like the broken line 212.

Please amend the paragraph beginning at page 19, line 24, as follows:

Another interesting non-constant envelope modulator that can be used in the present invention is a modulator for combined carrier signals. One embodiment of such a multi-carrier modulator is illustrated in FIG. 20. Here, two carriers of a GMSK modulation are combined, but it is also possible to combine carriers of other modulation schemes, e.g. 8PSK. Also, it is possible to combine carriers having different modulation schemes, e.g. one GMSK and one 8PSK carrier. Moreover, the basic ideas of this carrier combining can be generalized into more ~~that~~ than two carriers. However, in such cases, bandwidth restrictions may set a practical limit.

Please amend the paragraph beginning at page 22, line 7, as follows:

A way to reduce the problems described above is to renounce the demand of keeping the component amplitude constant. By letting the component amplitude decrease when the total signal amplitude becomes small, some advantages are achieved. The

required bandwidth will decrease and the total power efficiency will increase. However, ~~since the present invention is intended to operate also with amplifiers not being perfectly linear,~~ such component amplitude variations ~~have to~~should be kept within certain limits.

Please amend the paragraph beginning at page 22, line 23, as follows:

As described in the above embodiments, there are a number of interesting advantages arising by using one or more non-limiting examples of the present invention. One of the main advantages is the high flexibility in using the arrangement. A user may easily, even on a time slot basis, change between different transmitting configurations. It is thus possible to change e.g. between high capacity and high output power, depending on the actual need. No re-calibrations have to be performed and the changes typically involve solely software changes.